Identification and evaluation of nonlinear trends in hydrometeorological time series

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The discrete wavelet method can reveal the nonlinearity of trends and is therefore more effective than conventional methods for trend identification. In practice, however, the difference of discrete wavelet results between true components of a series and noise cannot be easily distinguished, and the statistical significance of nonlinear trends should hence also be evaluated. In this study, the discrete wavelet spectrum was established to quantify the difference between observed data and noise, based on which the discrete wavelet spectrum-aided method (DWSM) for identification of trend was developed. Results indicated that DWSM performed better than the Mann-Kendall test, because the latter usually overestimated (or underestimated) the statistical significance of nonlinear trend. The DWSM method can also accurately describe the nonlinear trend and was therefore superior. However, if there was too much noise in the series, the DWSM method could not identify all true components of the series, indicating the large impact of noise on the identification of periodicity and trend. Therefore, noise needs to be cautiously handled in hydrometeorological series analysis.